

DE RENZIS
Serial No. 09/437,469

Atty Dkt: 3572-14
Art Unit: 2877

THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) Method for measuring the distance of an object from a measuring device, comprising the following steps:

a) emitting a signal, wherein the emitted signal is a light beam adapted to illuminate the object along an emission optical path and said emitting step includes carrying out at least one scan on the object along at least one scanning line;

b) directing the signal towards an object;

c) detecting a signal diffused by the object, wherein the detected signal is an analogue electric signal representative of the luminous image diffused by the object along the scanning line;

d) carrying out a sampling of an analogue electric signal representative of a distance travelled by the emitted signal and the object diffused signal, so as to extract at least one sample x_k representative of at least one respective point of the scanning line and converting the sampled analogue signal into a digital signal so as to obtain a numerical value of said at least one sample x_k ;[;]

e) wherein, prior to carrying out step a) there is a measuring device calibration step so as to associate at least one calibration sample x_j of a calibration distance signal and a respective numerical value of said at least one sample x_j with a prefixed distance value;

f) identifying the prefixed distance value associated, in the previous calibration step, with the numerical value of said at least one sample x_k and corresponding at least one sample x_k obtained in step d); and

g) associating the prefixed distance value identified in step (f) with the numerical value of said at least one sample x_k obtained in step d).

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2. (Original) Method according to claim 1, further comprising the following steps:

- carrying out at least one scan on the object along at least one scanning line;
- measuring the distance of a plurality of points on the scanning line.

3. (Cancelled)

4. (Cancelled)

5. (Previously Presented) Method according to claim 1, comprising the additional step of storing the distance value obtained for sample x_k in step g) and iteratively repeating the previous steps starting from step d) for each further sample x_{k+1} , wherein $k=1, \dots, N$.

6. (Currently Amended) Method according to claim 1, wherein the calibration step comprises the following steps:

- emitting a signal carrying out at least one scan along a scanning line on a surface of known reflectance placed at a prefixed distance;
- acquiring an analogue electric signal representative of the reflectance of said surface along the scanning line;
- carrying out a sampling of a calibration analogue signal ~~representative~~ representative of the distance travelled by the emitted signal and the surface diffused signal, at a prefixed sampling frequency, so as to extract a plurality of calibration samples x_j , wherein $j=1, \dots, N$, representative of corresponding points on the scanning line;
- converting the sampled calibration signal representative of the distance into digital signal so as to obtain numerical values for said plurality of calibration samples x_j ;
- associating each calibration numerical value obtained for said plurality of samples x_j and corresponding sample x_j with the prefixed distance value at which the surface of known reflectance has been placed, and

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- iteratively repeating the previous steps for a prefixed number of times, each time moving the surface of known reflectance by a prefixed distance interval.

7. (Cancelled)

8. (Previously Presented) Method according to claim 6, wherein the calibration step further comprises the following steps:

- carrying out a plurality of scans of the surface of known reflectance along the scanning line;
- extracting a plurality of samples x_j for each scan, where $j=1, \dots, N$;
- obtaining a mean scan of the plurality of scans effected;
- processing the mean scan so as to obtain said numerical value for said at least one sample x_j .

9. (Original) Method according to claim 8, wherein the mean scan is obtained by calculating the arithmetical mean of the numerical values obtained for each sample x_j in the various operations of scanning effected.

10. (Previously Presented) Method according to claim 8, wherein the calibration step also comprises the step of filling with the prefixed distance values associated to the numerical values obtained for the calibration samples x_j , the items of a calibration matrix having, as index of column j a number from zero to the number of calibration samples x_j extracted, and as index of row i , a number from zero to the maximum value of the numerical value obtained after the analogue to digital conversion of the calibration signal representative of the distance.

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11. (Original) Method according to claim 10, further comprising the step of providing the matrix with a number of items (i, j) higher than the number of samples x_j , and filling the empty items (i, j) of the matrix.

12. (Original) Method according to claim 11, wherein the step of filling the empty items (i, j) of the matrix comprises the step of identifying, column by column, the empty items (i, j) of the matrix and filling each of these empty items with a value obtained by linearly interpolating between the two numerical values differing from 0 that are nearer to the empty item, and belonging to the same column.

13. (Original) Method according to claim 6, comprising the step of associating to said at least one sample x_j a respective linear position on the scanning line.

14. (Original) Method according to claim 13, wherein the step of associating to the sample x_j a respective linear position on the scanning line comprises the following steps:

- positioning on the scanning line, at a prefixed distance, a grid composed of alternated light and dark equally-spaced intervals having known dimension;
- detecting the intervals of the grid in sequence, storing each time the time needed to travel each interval of the grid, in an item of a calibration table;
- summing up each time all the items stored until that moment starting from the first one up to reach a known prefixed value representing the time at which a prefixed sample is generated;
- identifying the position of sample x_j on the scanning line as that point of the scanning line having a distance value from the scan starting point equal to the value obtained by the previously effected sum.

15. (Original) Method according to claim 1, further comprising the step of reading an optical code placed on the object.

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16. (Cancelled)

17. (Cancelled)

18. (Previously Presented) Method for measuring the distance of an object from a measuring device, comprising the following steps:

a) emitting a signal, wherein the emitted signal is a light beam adapted to illuminate the object along an emission optical path and said emitting step includes carrying out at least one scan on the object along at least one scanning line;

b) directing the signal towards an object;

c) detecting the signal diffused by the object, wherein the detected signal is an analogue electric signal representative of the luminous image diffused by the object along the scanning line,

d) carrying out a sampling of an analogue electric signal representative of the distance travelled by the emitted signal and the object diffused signal at a prefixed sampling frequency so as to extract at least one sample x_k representative of at least one respective point of the scanning line and converting the sampled analogue signal into digital signal so as to obtain a numerical value of said at least one sample x_k ;

e) wherein, prior to step a) there is a measuring device calibration step so as to associate at least one calibration sample x_j of a calibration distance signal and a respective numerical value of said at least one calibration sample x_j with a prefixed distance value;

f) identifying the prefixed distance value associated, in the previous calibration step, with the numerical value of said at least one sample x_k and corresponding at least one sample x_k obtained in step d); and

g) associating the prefixed distance value identified in step f) with the numerical value of said at least one sample x_k obtained in step d);

wherein the calibration step comprises the following steps:

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- emitting a signal carrying out at least one scan along a scanning line on a surface of known reflectance placed at a prefixed distance;
- acquiring an analogue electric signal representative of the reflectance of said surface along the scanning line;- carrying out a sampling of a calibration analogue signal representative of the distance travelled by the emitted signal and the surface diffused signal, at a sampling frequency equal to the one prefixed, so as to extract at least one calibration sample x_j representative of at least one corresponding point on the scanning line;
- converting the sampled calibration analogue signal representative of the distance into digital signal so as to obtain a numerical value for said at least one calibration sample x_j ;
- associating each calibration numerical value obtained for said at last one sample x_j and corresponding calibration sample x_j with the prefixed distance value at which the surface of known reflectance has been placed, and
- iteratively repeating the previous steps for a prefixed number of times, each time moving the surface of known reflectance by a prefixed distance interval, wherein the calibration step also comprises the steps of
- filling with the distance values associated to the calibration numerical values obtained for the calibration samples x_j , the items of a calibration matrix having, as index of column j a number from zero to the number of samples x_j extracted, and as index of row i , a number from zero to the maximum value of the numerical value obtained after the analogue to digital conversion of the signal, wherein filling the empty items (i, j) of the matrix comprises the step of identifying, column by column, the empty items (i, j) of the matrix and filling each of these empty items with a value obtained by linearly interpolating between the two numerical values differing from 0 that are nearer to the empty item, and belonging to the same column; and
- providing the matrix with a number of items (i, j) higher than the number of samples x_j ;

19. (Cancelled)

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20. (Previously Presented) Method according to claim 1, wherein said signal representative of the distance is the detected signal diffused by the object.

21. (Previously Presented) Method according to claim 1, wherein said calibration signal is the detected signal diffused by the surface of known reflectance.

22. (Previously Presented) Method according to claim 1, wherein said signal representative of the distance is a comparison signal obtained comparing the detected signal diffused by the object with the emitted signal.

23. (Previously Presented) Method according to claim 1, wherein said calibration signal is a comparison signal obtained comparing the detected signal diffused by the surface of known reflectance with the emitted signal.

24. (Previously Presented) Method according to claim 1, wherein the signal representative of the distance is sampled at a frequency equal to the prefixed sampling frequency of the calibration signal.